

WHAT IS CLAIMED IS:

1. A method for laser peening a workpiece, the method comprising:

generating a laser pulse from a substantially single-transverse-mode oscillator;

5 modifying said laser pulse with a pulse sharpening device;

means for amplifying said laser pulse; and

directing said laser pulse to the workpiece.

2. The method of Claim 1 wherein said oscillator provides means for compensating for stress birefringence.

3. The method of Claim 2 wherein said oscillator comprises a dual-pump-cavity configuration with a 90 degree rotator between the pump cavities.

4. The method of Claim 2 wherein said oscillator further comprises a porro prism.

5. The method of Claim 1 wherein said oscillator also provides means for generating a single-longitudinal-mode laser pulse.

6. The method of Claim 5 wherein said means for generating a single-longitudinal-mode is a seed laser.

7. The method of Claim 5 wherein said means for generating said single-longitudinal-mode laser pulse is an etalon.

8. The method of Claim 1 wherein said oscillator contains an aperture with an opening of less than 5 mm.

9. The method of Claim 1 wherein said oscillator utilizes a

gradient reflector.

10. The method of Claim 1 wherein said pulse sharpening device is an electro-optical pulse slicer.

11. The method of Claim 10 wherein said pulse sharpening device is used to modify both the leading edge and the trailing edge of said laser pulse.

12. The method of Claim 1 wherein said pulse sharpening device is a phase conjugation cell.

13. The method of Claim 1 wherein said amplifying means is a series of Nd:glass amplifiers.

14. The method of Claim 13 wherein said amplifying means further comprises a means for birefringence compensation of the laser pulse as said laser pulse passes through said amplifying means.

15. The method of Claim 14 wherein said means for birefringence compensation is a 90 degree rotator.

16. The method of Claim 1 wherein said amplifying means is a multi-pass amplification.

17. The method of Claim 16 wherein said multi-pass amplification comprises a phase conjugation device and a means for birefringence compensation.

18. The method of Claim 17 wherein said means for birefringence compensation is a 90 degree rotator.

19. An apparatus for laser peening a workpiece, said apparatus comprising:

a substantially single-transverse-mode laser oscillator;

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a laser pulse-sharpening device;
means for amplifying a laser pulse; and
a laser peening cell.

20. The method of Claim 19 wherein said oscillator also provides means for compensating for stress birefringence.

21. The method of Claim 20 wherein said oscillator comprises a dual-pump-cavity configuration with a 90 degree rotator between the pump cavities.

22. The method of Claim 20 wherein said oscillator further comprises a porro prism.

23. The method of Claim 19 wherein said oscillator also provides means for generating a single-longitudinal-mode laser pulse.

24. The method of Claim 23 wherein said means for generating a single-longitudinal-mode is a seed laser.

25. The method of Claim 23 wherein said means for generating said single-longitudinal-mode laser pulse is an etalon.

26. The method of Claim 19 wherein said oscillator contains an aperture with an opening of less than 5 mm.

27. The method of Claim 19 wherein said oscillator utilizes a gradient reflector.

28. The method of Claim 19 wherein said pulse sharpening device is an electro-optical pulse slicer.

29. The method of Claim 28 wherein said pulse sharpening device is used to modify both the leading edge and the trailing edge of said laser pulse.

30. The method of Claim 19 wherein said pulse sharpening device is a phase conjugation device.

31. The method of Claim 19 wherein said amplifying means is a series of Nd:glass amplifiers.

32. The method of Claim 31 wherein said amplifying means further comprises a means for birefringence compensation of the laser pulse as said laser pulse passes through said amplifying means.

33. The method of Claim 32 wherein said means for birefringence compensation is a 90 degree rotator.

34. The method of Claim 19 wherein said amplifying means is by multi-pass amplification.

35. The method of Claim 34 wherein said multi-pass amplification comprises a phase conjugation device and a means for birefringence compensation.

36. The method of Claim 35 wherein said means for birefringence compensation is a 90 degree rotator.

37. The apparatus of Claim 19 further including a telescope.

38. The method of Claim 1 in which said generating step includes utilization of a telescope within the oscillator.